Experiencing design with grammatical explorations in the beginning design studio

The after-recognition experiment: designing with constraints

Ibrahim, Mohamed S.; Bridges, Alan; Chase, Scott Curland; Bayoumi, Samir; Taha, Dina S.

Published in:
Respecting Fragile Places

Publication date:
2011

Document Version
Publisher's PDF, also known as Version of record

Experiencing design with grammatical explorations in the beginning design studio

The after-recognition experiment: designing with constraints

Mohamed S. Ibrahim[1], Alan Bridges[2], Scott C. Chase[3], Samir Bayoumi[4], Dina S. Taha[5]
[1, 4, 5]Alexandria University, Egypt, [2]Strathclyde University, UK, [3]Aalborg University, Denmark
[1]Mohsobhy77@gmail.com, [2]a.h.bridges@strath.ac.uk, [3]scha@create.aau.dk, [4]samir_ hosni@hotmail.com, [5] ditaha@alexu.edu.eg

Abstract. *This paper describes a teaching experience conducted and carried out as part of the coursework of first year students of architecture in two different countries. The workshop is the second of three workshops planned to take place during the course of the first year studio, aimed at introducing new ways of thinking and introducing students to a new pattern of architectural education.*
The experiment was planned under the theme of "Production" in the mid-stage that is considered the operational stage of the design process. It also succeeded a recognition stage in which the students' visual reasoning skills were targeted with more open and less determined design tasks. A grammatical approach was chosen to deliver the methodology in the design studio, based on the shape grammar methodology.
Keywords. *Beginning/Novice students; shape grammar; pedagogical grammar; design education.*

INTRODUCTION

The presented work is based on a pedagogical model (Ibrahim et al., 2010) that structured the first year studio and divided it into three consequent stages: recognition, production then evaluation (figure 1).

Three experiments were scheduled to take place accordingly over the course of each stage in order to evaluate the effectiveness of the framework in delivering the planned learning outcomes for each stage. The early stage experiments were crafted with a main goal of nurturing the skill of seeing; with more creative and ill-defined design tasks, the mid stage ones utilize formal strategies to help students designing with constraints; while the final stage's tasks aim at creating a comprehensive architectural design experience with real, yet simple and comprehensive design problems. This paper discusses the mid stage (production experiment), giving also a glance on the implementation of grammar in the beginning studio.

THE INTRODUCTION OF GRAMMAR IN THE FIRST YEAR STUDIO

Driven by its success in analysing and synthesizing design, shape grammar has been brought into design education in various forms(Stiny and Gips, 1972). In many instances it is introduced as a generative design methodology during design computation classes, and in other occasions it is highlighted

as a design methodology in specific design projects through design studio work.

Despite these interesting facts, there is no comprehensive literature on the use of grammatical systems for the beginning design studio education. The methodology is thought to be well-suited for teaching beginners from other different theoretical aspects:

- The grammar's concept is mainly about "making tacit knowledge explicit", the problem that is mainly addressed throughout the first year studio with inexperienced students (Pantazi, 2008). A pedagogical grammar therefore could benefit from manifesting this implicit knowledge in a more abstracted way.
- The grammar development and application stages expose some of the main design strategies (subdivision, addition, grid, etc.), principles (balance, harmony, rhythm, etc.) and even simple compositional operations (rotation, symmetry, transition, etc.). The implicit teaching of these issues within the grammar's process makes the methodology more relevant for teaching beginners composition and visual correlation (Knight, 1999; Economou, 2000).
- Some of shape grammars' scenarios manage to capture the layout of the design process and adjust students to it. The cognitive operations of cognition, production as well as evaluation are implicitly embedded in these scenarios in a way that promises beginners development of a good understanding of and control over their own design processes.
- The methodology is also very significant to be used under the studio's project based approach as the implementation stage of synthetic shape grammars involves a playful "Making" process. This could be clearly seen in some early examples like Fleming's wall grammar (Flemming, 1990).
- Other examples such as Knight's work with UCLA students (Knight, 1999) and the Wright Prairie grammars (Koning and Eizenberg, 1981) show the power of this simple mechanism to inspire students in producing large and complex designs in their studio experimentations.

To apply the grammar in the beginning studio structure, its deterministic, strictness and unequivocal nature will be the main aspect of the methodology to be reconsidered in order to keep the process open in every stage of the structure's model. The applied model will be a more general interpretation of the theory that promises some degree of flexibility in its vocabularies and rules' description to allow all these reinterpretation and changing situations to occur.

THE MID STAGE: PRODUCTION

Designing with constraints /design generators

The production stage is the making phase, the most playful and creative of the design process, in

Figure 1
The three stages of the beginning design studio (Ibrahim et al., 2010).

which architects form ideas and possible solutions that might address the goals, constraints, and opportunities established during the problem analysis phase of the process. For tutors, the act of making is most important in increasing the students' understanding of the object or space being drawn; this understanding can therefore be translated into a "remembered experience" which subsequently forms the basis for a repository of memories and experiences that one draws upon in the design process. This is essential in order to develop the targeted expertise in beginning design students. The real difficulty associated with this stage is not just the formal composition of a solution itself; recognizing the nature of the design problem, its constraints and most importantly to respond to it with the appropriate solution is the very important yet ill-defined skill to be learnt.

Constraints act as filtration factors for the design solutions; they are also stimuli for the design generation (Lawson, 2006).The diversity in its functions, typologies and originators can easily be seen reflected in the range of design approaches being followed. Tracing the conceptual change in the design reaction will most likely lead us to the search for the associated actions generated by the constraints themselves. Identifying and understanding the constraints at this stage is thought to be a key for the appropriate solution.

THE EXPERIMENT: "DOING SHAPES"

The experiment grammar (subdivision grammars)
The implemented grammar was based upon the analysis of some of Richard Meier's house elevations. The main idea behind the grammar is that each elevation can be analyzed as a parallelogram subdivided with two simple rules of subdivision: vertical and horizontal (Figure 2), into three different types of volumes: solid, glass and void. In the grammar, those volumes are labelled in yellow, blue and green (Figure 3).

Presented in 2D, the elevation grammar begins with an initial rectangular layout. The grammar's development occurs in three sequential steps (Figure 4):

1. Subdivision: subdividing the rectangle and labelling the subdivided zones.
2. Layering: merging similar zones with similar Z values, projecting and moving layers in order to give the 2D elevations a three dimensional perspective.
3. Articulating (refinement): giving some of the language and refinement details (this step was not introduced in the experiment)

The pedagogical version of the grammar is a less descriptive and more general one. The studio's methodology is built only on two phases of the grammar: one is the subdivision and labelling step and the other is the layering and projecting one.

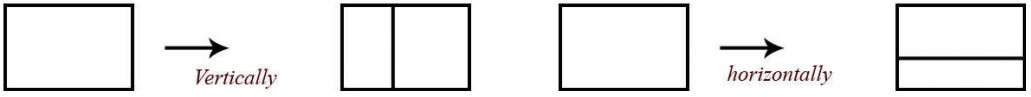


Figure 2
The two main subdivision rules.

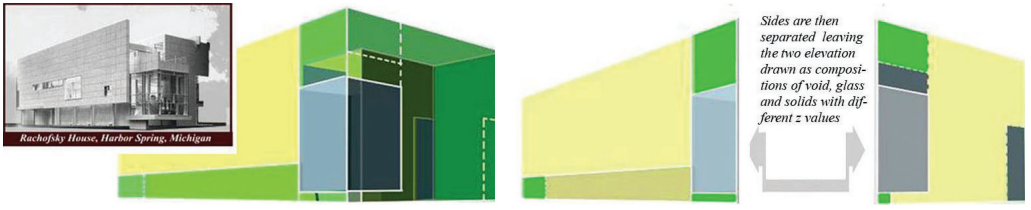


Figure 3
The main concept of the subdivision grammar.

Introductions of Constraints / References

References are more like labels in grammar, used to guide the subdivision and avoid the defragmentation of the designed subject. They are mainly groups of values, lines or codes that are marked on the original master layer as guidelines to snap the subdivision to them. These guidelines represent some of the design's constraints and considerations. Some are mandatory like structural /floor levels and legislation; some concern design decisions like the respected module, human scale and the code of functions behind the facades; while others reflect design principles like rhythm, proportions, etc. (Figure 5).

These "references" also prevent the process from proceeding aimlessly, causing the design to disconnect from its functional context or whatever logical purposes it stands for.

The Workshop

The workshop took place four months from the beginning of the year and was conducted with two groups of students:

- Group A, Strathclyde University students (UK): within a project based studio curriculum, students have some familiarity with "design" as they were confronted with designing and making from the beginning of the year.
- Group B, Alexandria University students (EGY): studio education here is mainly about fundamentals and basic design. Students have not been subjected to any kind of designing or modelling activities, yet they have fair amount of knowledge about drawing techniques, design principles, etc.

In the introductory lecture, the general idea

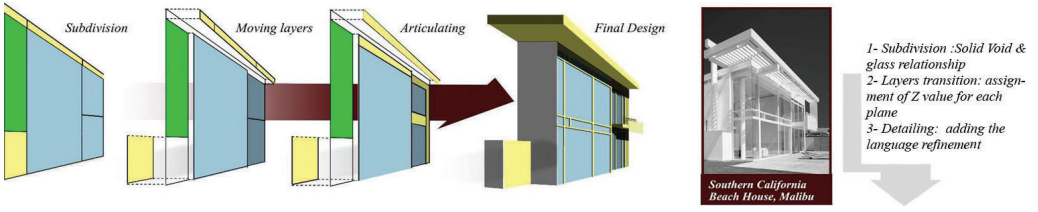


Figure 4
The main subdivision grammar steps.

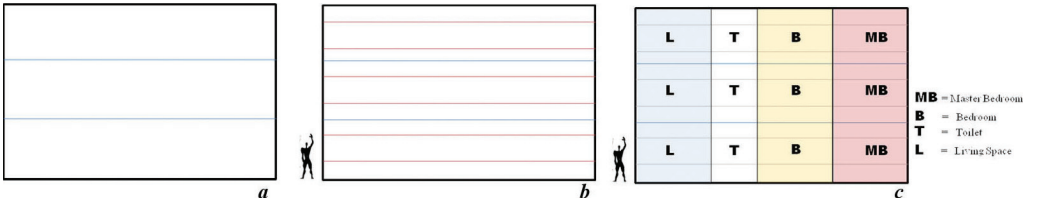


Figure 5
The initial shape's master layer and the References different levels of complexity (a) floor level references only (b) the addition of work and maximum reach level (c) other codes for the functions behind the façade.

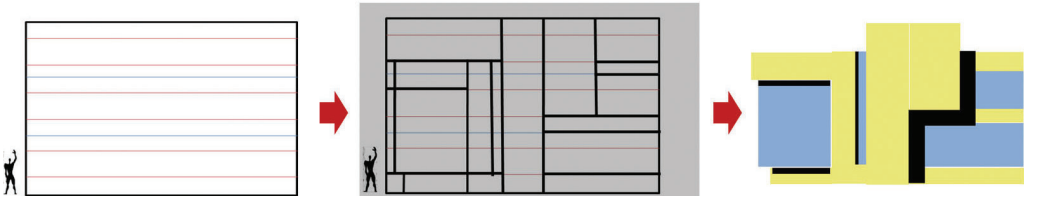


Figure 6
Designing a subdivision with respect to human scale references.

of extracting the design vocabularies and applying rules was revisited. Students were given a 20 minutes talk about design strategies, including subdivision. Each strategy's features were illustrated with architectural and non-architectural examples. Later, subdivision was brought into the discussion as the experiment's implemented strategy. Students were questioning the variety it can produce with limited rules and fixed output layout. The idea therefore was to challenge their assumptions with the diversity of designs produced by the same strategy.

The concept of the subdivision grammar was demystified and demonstrated with some of Meier's examples. Afterwards, the idea of references was illustrated with some examples, showing its different types and combinations as well as its way of controlling the subdivision in the grammar (Figure 6).

In groups of five, students were given a facade design assignment (Figure 7), in which they had to use the subdivision strategy in designing an abstract facade for a building in a historical context. They were asked to begin by selecting their own preferences for guidelines (constraints or idea generator) for the master layer, selecting from a range that includes internal (the building's information, function and spaces) and external (guidelines from the surrounding context) constrains. The students' work was carried out in the traditional studio environment with sketches and 3D models.

OBSERVATIONS

Once the abstractness of the design problem fades away, unveiling some concrete meanings, the students' response becomes more significantly affected by their own perception of the problem. With regard to the given example (Figure 7), the problem is clearly architectural, i.e. a facade design. It was therefore not unexpected to see some architectural reflections in the students' work from their surrounding environments. These reflections are the outcomes of what could be described as contextual preconceptions.

For some students, the effect of these mind-sets was strong enough to interfere and conflict with their understanding. Their conflicted perception misled them to clearly render versions of the surrounding context images in their work, overlooking any given instructions about the abstractness of the masses and the subdivision mechanism.

Concerning these unexpected design outcomes, the interaction between the beginners of both groups and their surrounding environment was shaped by:

- The image: the characteristic of the surrounding architectural context which accumulatively

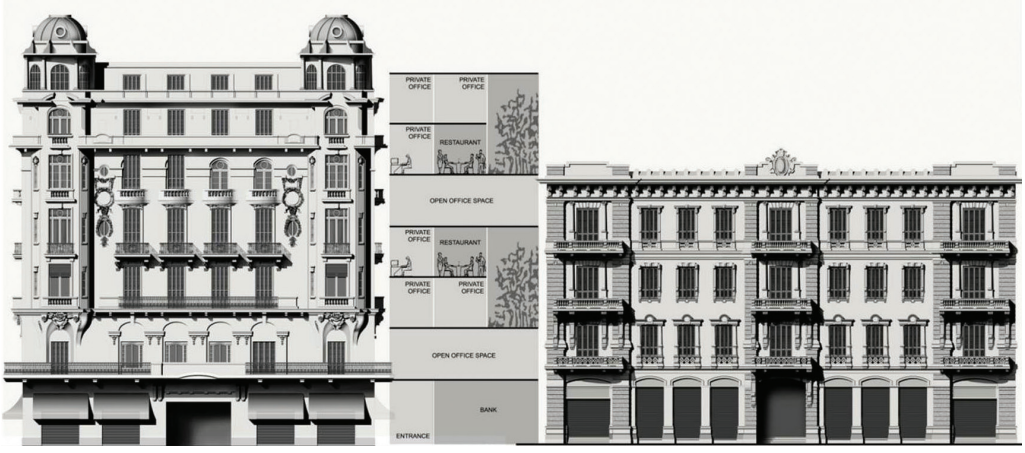


Figure 7
The assignment: a façade in a historical context.

formed their architectural memory. The health of the surrounding architectural and urban environment also affected their architectural taste, their basic understanding of forms' conception, as well as their ability to visually communicate in a proper way. Figure 8 shows some replications of Alexandria's eclectic facade features like pediments and triangular patterns.

- The perception: the way in which students perceived and translated these contextual images, whether by inspiration or direct imitation of the surrounding architecture features in their designs. This expands the students' visual repository of good examples as well as enabling them to early experience design; both are effective ways of refining their expertise and developing good intuition. Figure 9 illustrates the imitation of different local and international styles in group A's student work.

Even though students in group A missed the main concept of subdivision in the first instance, they captured and understood the use of references in their designs. They managed, to an extent, to successfully design with constraints. During their on-going design project (To Dwell), students were expected to design a facade for a building in a historical context. Their work sketches showed them using the same idea of references. They mostly used external references that link the facade to its neighbourhood rather than only following internal ones that respect the function and structure behind the designed facade. In the analysis of their design project (Figure 10), their notes showed how they also proposed new external references that were not mentioned in the tutorial about the colour and materiality of the surrounding buildings.

While group B students managed to understand the use of references as well, their selections were limited to the ones proposed in the tutorial and more precisely to the internal references more than the externals.

The same defect is believed to be caused either by the students' continuous search to solve defined

Figure 8
Group B's unexpected designs neglecting the whole mechanism of horizontal and vertical subdivision; instead, they deliberately drew entrances, windows and balconies to define its functions (some of Alexandria's eclectic features that appeared in the students designs from the use of the main building's pediment to smaller triangular ones defining the windows).

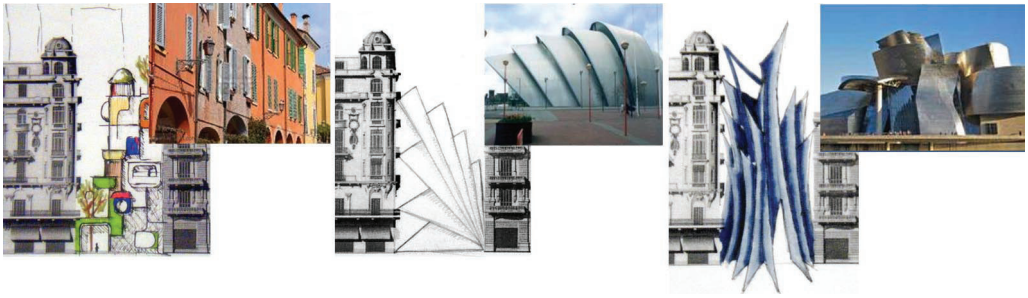


Figure 9
Some of Group A's unexpected designs, showing imitations to the local and international architectural styles.

Figure 10
The group A students' (To dwell) sketches after the first workshop, showing the use of references in designing the façade: notes on the sketches propose lots of different external references to respect, like rooflines, materials and colours of the adjacent facades.

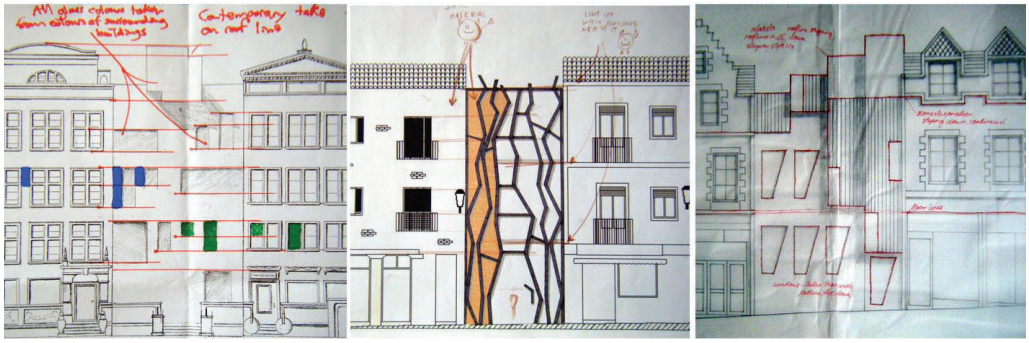


Figure 11
Group B students' stand-alone examples.

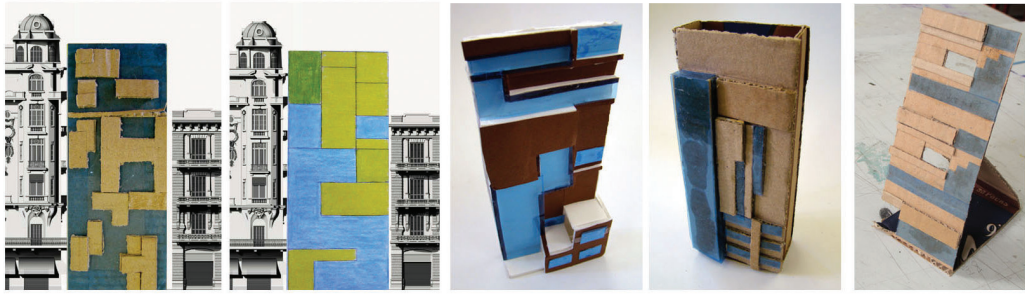
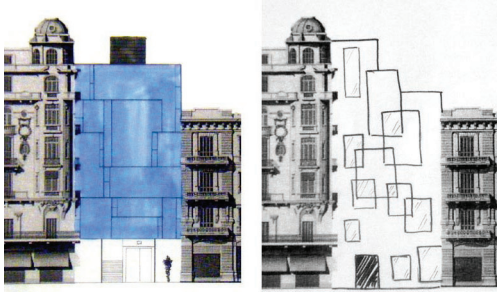


Figure 12
Some group A student work during the first workshop.



problems or their eagerness to design that disconnects the subject being designed from its contextual meaning. It is also worth mentioning that, although these designed facades exhibit some good design qualities, the still is a lack of the proper connection with the surrounding context (Figure 11).

Although all students applied two structured rules in the development of their design compositions, the solutions were innovative and diverse. No facade was produced that was identical to another (Figure 12 & Figure 13.)

Despite being the first architectural design assignment for group B, and regardless of the naivety of some of their designs in addition to the unexpected outcomes, the results showed that the process is capable of producing interesting, viable and innovative designs .The richness of the students' work demonstrated that the application of rigid rules does not interfere in the creative process.

CONCLUDING REMARKS

Giving time for proper preparation, the experiment was reintroduced with a new introductory exercise that trained students on the technique and the use of references before proceeding to main design experiments (Figure 14).

The implemented shape grammars proved being an appropriate design method for delivering the goals

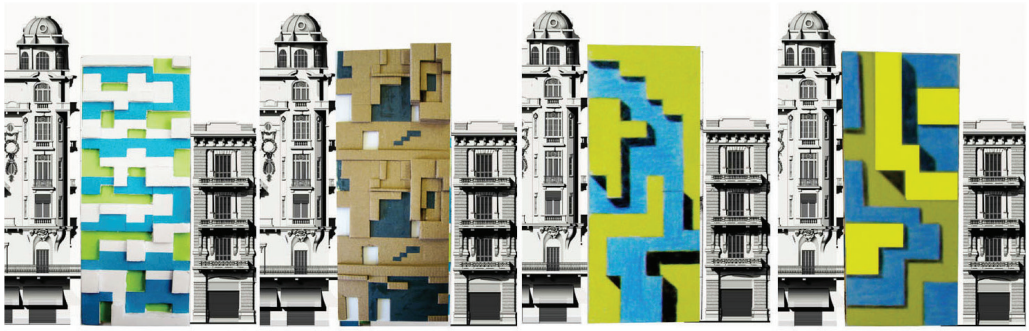


Figure 13
Some group B student façade designs in the hypothetical architectural context.

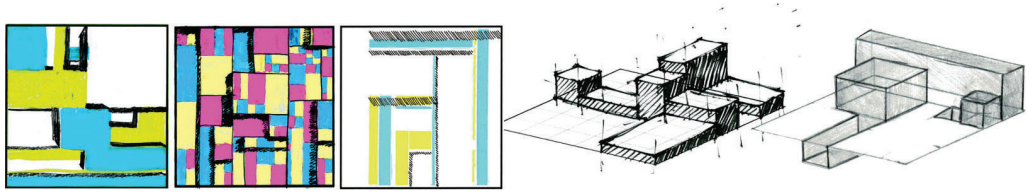


Figure 14
Some of the students' work during the preliminary example.

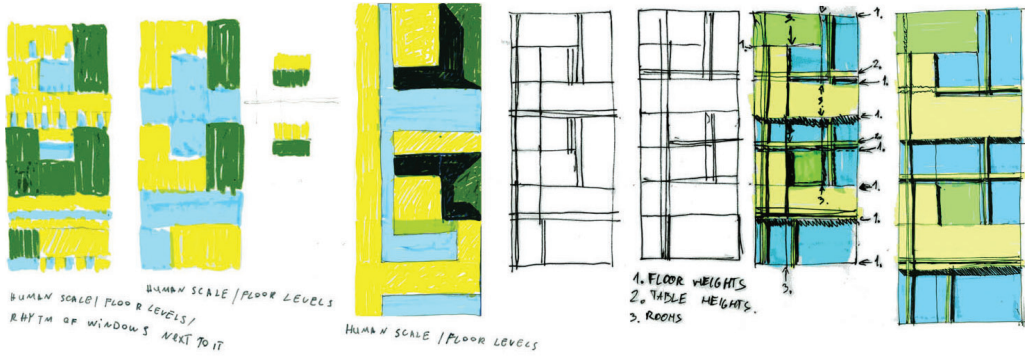


Figure 15
Group A work progress during the remaking of the workshop (the second extended version of the workshop).

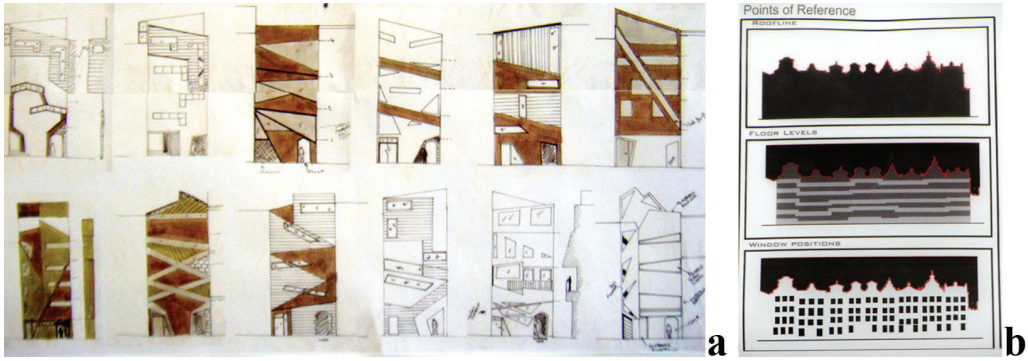
of the mid stage. In the presented case, and especially in the remaking of the workshop (Figure 15 & Figure 16), the selected methodology provided students with a simple, interesting and playful making mechanism that enabled them to start designing with constraints.

Another preconception highlighted in the feedback session was the students' perspective of the differences between mimicking and inspiring from a subject. Most novices tend to begin inspiring in their designs by imitating outlines and features. The workshop's experiment provided students with values, codes, levels, proportions, rhythms and other aspects to inspire from and design accordingly instead of the direct imitation of the surrounding environment.

Not only are the two subdivision rules straightforward, but the selected design subject (the facade design) was simple enough to enable the students to connect their designs with the subject and context from the very first beginning of the design process.

Figure 16
Group B work for the second version of the workshop.

Figure 17
Part of the students' final projects, influenced by the subdivision mechanism and showing the analysis of the points of references.



It is also evident that the quantitative and qualitative introduction of constraints didn't hamper the flow of the design process, nor did it prevent the generation of innovative designs.

The teaching experiment was highly evaluated by both students and teachers. The discussion on the results touched on the subject of creativity and the way rules and structure can enhance a design process. Some of the students were influenced by the mechanism of subdivision in their latter projects (Figure 17a) but most importantly was their tendency to use references to describe the linkage between their designs to external or internal constraints (Figure 17b).

Following the success of the grammar in the students' work, the prospect of using CAAD programs should be considered in the future to assist with the traditional studio methods. Such implementation can increase the number of alternatives as well as facilitate the study of the third dimensional transformation of the facade (the layering stage).

REFERENCES

Economou, A 2000, 'Shape Grammars in Architectural Design Studio' in Mitchell, W, Fernandez, JE (eds), *2000 ACSA Technology conference*, Hong Kong.

Flemming, U 1990, 'Syntactic structures in architecture: teaching composition with computer assistance' in M McCullough, W J Mitchell (eds), T*he Electronic Design Studio: Architectural Knowledge and Media in the Computer Era*, MIT Press, Cambridge, Mass, pp. 31-48.

Ibrahim, MS, Bridges, A, Chase, SC, Bayoumi, S and Taha, D 2010, 'Use of Grammar for Shape Exploration with Novice Students' in Schmitt, G et al. (eds), *Future Cities, Proceedings of the 28th Conference on Education in Computer Aided Architectural Design in Europee 2010*, vdf Hochschulverlag AG, Zurich, pp. 115-124.

Knight, T 1999. 'Shape grammars in education and practice: history and prospects', *International*

Journal of Design Computing, 2, http://wwwfaculty.arch.usyd.edu.au/kcdc/ijdc/vol02/papers/knightFrameset.htm

Koning, H and Eizenberg, J 1981 'The language of the prairie: Frank Lloyd Wright's prairie houses', *Environment and Planning B*, 8, pp. 295-323.

Lawson, B 2006, *How designers think: the design process demystified,* Architectural Press.

Pantazi, ME 2008, *Dissecting design: exploring the role of rules in the design process*, SMArchS thesis, Massachusetts Institute of Technology.

Stiny, G and Gips, J 1972, 'Shape grammars and the generative specification of painting and sculpture' in C. Freiman (ed), *Information processing 71*, North-Holland, Amsterdam, pp. 1460-1465.